



# Stone Masonry

## INTRODUCTION

Stone is an economical material used in the construction of buildings and various building parts. In some parts of our country, stones are abundantly available in nature. These are cut and given different shapes as per the need.

## CATEGORIES OF STONE

Stones are categorised depending on their use in the construction of building structures and location. The categories of stone have been discussed as follows.

Selection of stones for masonry depends on the availability, ease of working, appearance, strength and stability, polishing characteristics, economy and durability.

**Table 1.1: Stones used for different purposes**

S.No.	Purpose	Stone used
1.	Heavy engineering work, e.g., docks, breakwaters, lighthouses, bridge piers	Granite and gneiss
2.	Buildings situated in industrial towns	Granite and compact sandstones

3.	Pavements railway ballast, door sills and steps	Granite and ballast
4.	Fire resistance works	Compact sandstone
5.	Carving and ornamental works	Marble and laterite
6.	Facelift and architectural purposes	Marble, granite and closer grained sandstone

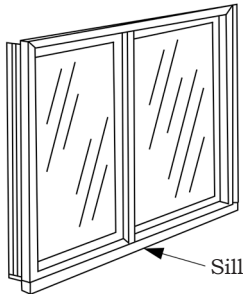


Fig. 1.1: Sill

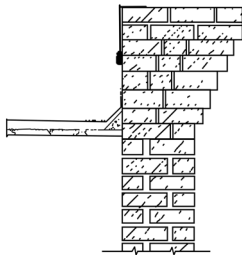


Fig. 1.2: Corbel

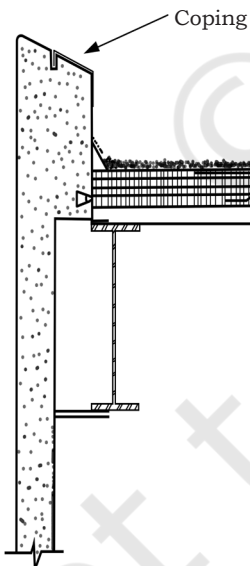
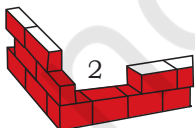


Fig. 1.3: Coping



## Sill

It is the bottom surface of a door or window opening (Fig. 1.1). Sill stones are dressed in a way that they prevent the entry of water into the building.

## Corbel

It is a projecting stone, which is used to provide support to roof truss, beam and weather sheds, etc. (Fig. 1.2). Corbels are, generally, moulded and given ornamental treatment. The corbels should extend at least two-third of their length into a wall.

## Cornice

It is a decorative border around the top of walls in a room or on the outside walls of a building. In other words, it is the uppermost horizontal area that appears like moldings along the top of a wall or just below a roof line. Stone is used to make cornice. Cornice overhang is used to protect the building's walls. It is, usually, painted to make it waterproof and weather resistant.

## Coping

To protect the walls of a building from rainwater, a course of stones are laid at the top of the wall or parapet wall. It is known as 'coping'. These stones are weathered and threaded for better resistance and durability (Fig.1.3).

## String Course

When a horizontal projected course of masonry is provided between the plinth and cornice, it is called

‘string course’. The purpose of string course is to provide architectural features, as well as, to check rainwater impact in buildings.

### Through Stone

It refers to a stone that is set with its longest dimension perpendicular to the face of a wall and the length of which is equal to the thickness of the wall (Fig.1.5). Such stones are known as through stones. The through stone should be strong and of sufficient thickness so as to avoid the danger of fracture due to any slight settlement of the wall.

### CLASSIFICATION OF STONE MASONRY

Based on the arrangement of stones in construction and degree of refinement in the surface finish, stone masonry can be classified into rubble and ashlar masonry.

#### Rubble Masonry

In rubble masonry (also called rubble-work), stones of irregular sizes are used in construction of walls. The stones, as obtained from quarry are broken with the help of a hammer. The strength of rubble masonry depends on these factors.

- Quality of mortar
- Use of long through stones at frequent intervals
- Proper filling of mortar in space between stones

#### Classification of rubble masonry

Rubble masonry is classified into the following categories:

- (a) Coursed rubble
- (b) Uncoursed rubble
- (c) Random rubble
- (d) Dry rubble
- (e) Polygonal rubble
- (f) Flint rubble

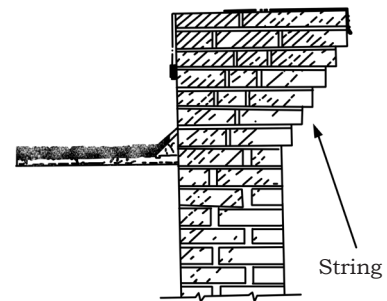
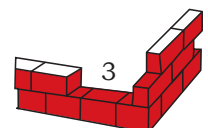


Fig. 1.4: String course



Fig. 1.5: Through stone



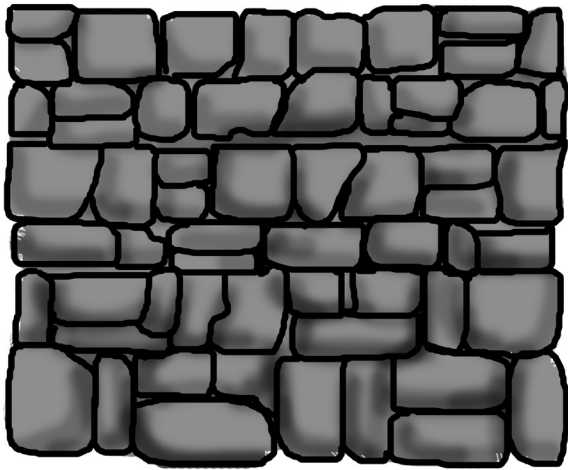


Fig. 1.6: Coursed rubble masonry

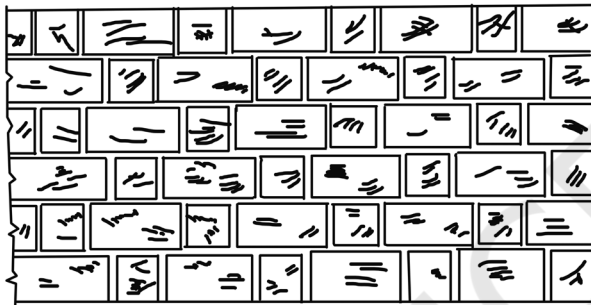


Fig. 1.7: Coursed rubble masonry—Class I

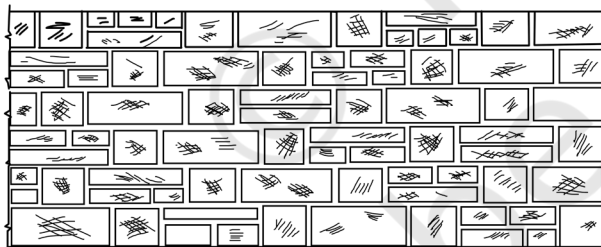


Fig. 1.8: Coursed rubble masonry—Class II

### ***Coursed rubble***

This type of masonry is commonly used in the construction of low height walls of public and residential buildings, abutment and piers of ordinary bridges. In this type of masonry, the height of stones varies from 5 to 200 mm. The masonry work carried out in this course is such that the height of stones in a particular course should be the same. Coursed rubble masonry is further divided into three categories.

#### ***Coursed rubble masonry—Class I***

In this type, stones of the same height are used and the courses are also of the same heights (Fig.1.7).

#### ***Coursed rubble masonry—Class II***

This type is similar to Class I, except that:

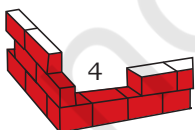
- the stones to be used are of different heights.
- the courses need not to be of equal heights.
- only two stones are to be used to make up the height of one course.
- the thickness of mortar joint is 12 mm.

#### ***Coursed rubble masonry—Class III***

This type is similar to Class I, except that:

- the stones to be used are of different heights, the minimum being 50 mm.
- the courses need not be of equal heights.
- only three stones are to be used to make up the height of one course.
- the thickness of the mortar joint is 16 mm.

GENERAL MASON – CLASS XI





### ***Uncoursed rubble masonry***

When stones from quarry are used without any dressing, except knocking out some coarseness, then it is known as uncoursed rubble masonry. The courses are not uniformed and no maintenance is required. In this masonry, larger stones are fixed in bottom and spaces between these stones are filled up by means of small stones known as spall (Fig. 1.9). The height of wall made with this masonry can vary from 30 cm to 50 cm. This rubble masonry is used for construction of compound walls, garages, godowns, etc. Cost of this masonry is the cheapest.

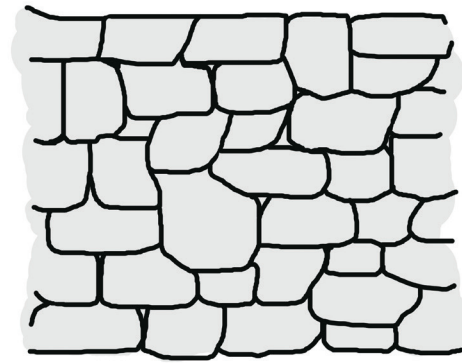


Fig. 1.9: Uncoursed rubble masonry

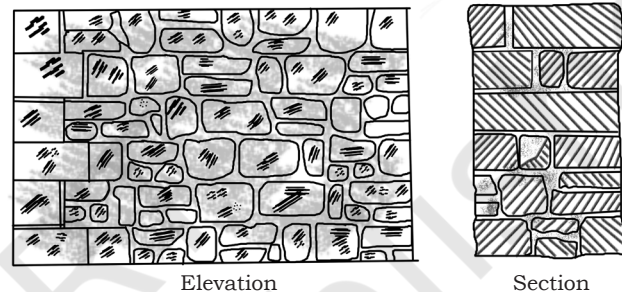


Fig. 1.10: Random rubble masonry



Fig. 1.11: Uncoursed random rubble masonry



Fig. 1.12: Dry Rubble Masonry

### ***Random rubble masonry***

This type of masonry consists of stones of irregular sizes and shapes. The stones are arranged in such a pattern that gives good appearances. It is a specialised job and requires skilled personnel to make the structure stable.

Uncoursed random rubble masonry is made by stacking stones of different sizes and qualities. Weak corners and edges of the stone are removed by hammer.

### ***Dry rubble masonry***

In this masonry, no mortar is used in joints. It is similar in construction to coursed rubble masonry. This type of construction is the cheapest but it requires more skill in construction. It is preferred for compound walls pitching on bridge approaches, retaining walls,

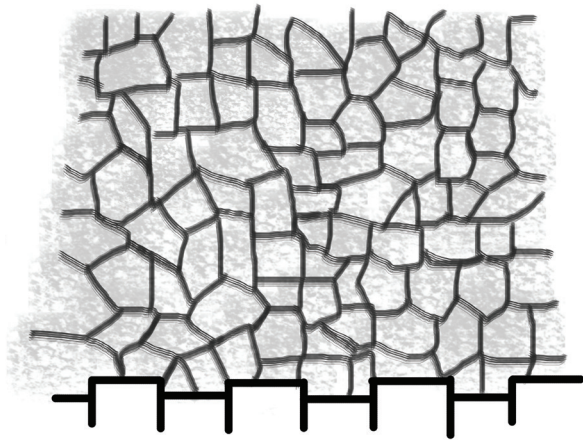


Fig. 1.13: Polygonal rubble masonry

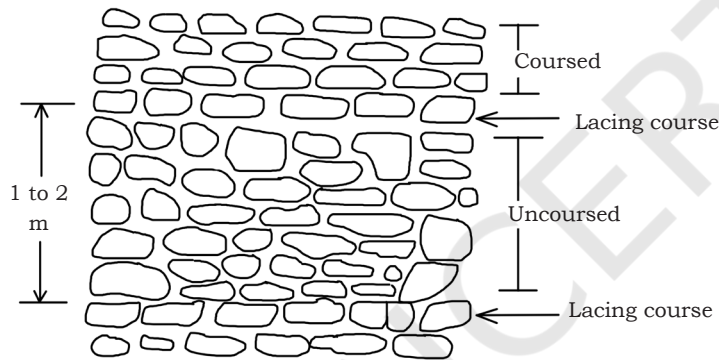


Fig. 1.14: Flint rubble masonry

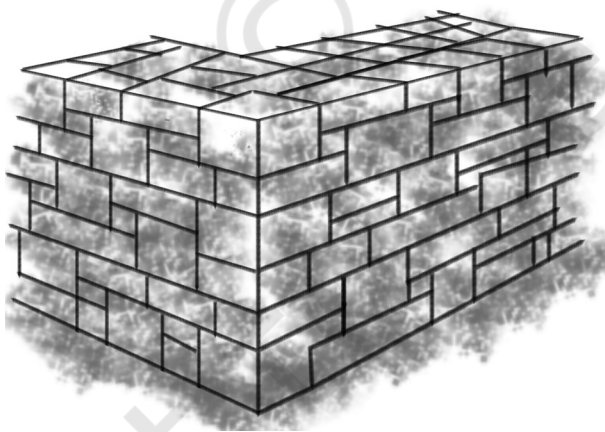
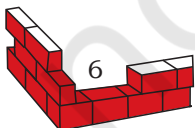


Fig. 1.15: Ashlar Masonry



etc. To avoid displacement of stones, two courses at the top and about 50 cm length at the ends may be built in mortar.

### **Polygonal rubble masonry**

It is a technique of stone wall construction. In this masonry, visible surfaces of the stones are dressed in such a way that the block appearance looks like a polygon. It is a special technique of masonry. More skill is required in the construction of this type of masonry.

### **Flint rubble masonry**

In this type of masonry, the stones used are called flints. The flint stones varying in thickness from 8 to 15 cm and in length from 15 to 30 cm, are arranged in the form of coursed or uncoursed masonry. In the case of buildings in coastal areas, the rounded flints procured from beaches are used. The joints of flint rubble masonry are slightly raked back with a pointed stick to improve the appearance.

### **Ashlar Masonry**

This is considered to be a superior quality of masonry. This is built from accurately dressed stones with uniform and very fine joints. The various types of ashlar masonry can be classified as:

- (a) Ashlar fine
- (b) Ashlar rough tooled



- (c) Ashlar rock or quarry faced
- (d) Ashlar chamfered
- (e) Ashlar facing
- (f) Ashlar block in course

### Ashlar fine

At all beds joints and faces stones should be dressed perfectly so that they confirm to the desired pattern (Fig. 1.16). The stones are arranged in proper bond and the thickness of the mortar joint does not exceed 3 mm. This gives perfectly smooth appearance but it is costly in construction.

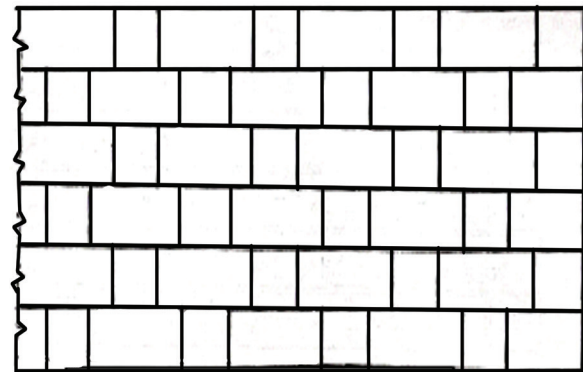


Fig. 1.16: Ashlar Fine

### Ashlar rough tooled

The size of stones bond, etc., have similar specification as described in case of ashlar fine masonry. The exposed face of this masonry should be given a fine dressed, chisel drafting of about 25 mm in width. The thickness of mortar joint does not exceed 6 mm.

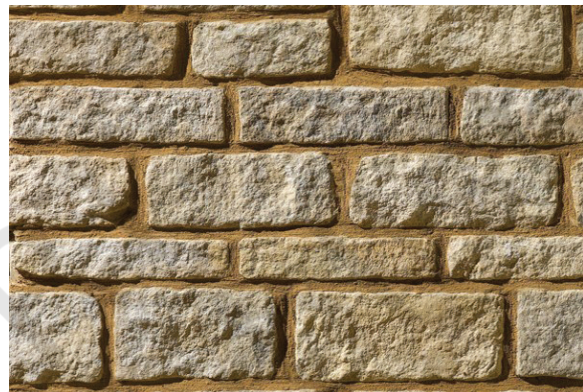


Fig. 1.17: Ashlar rough tooled masonry

### Ashlar rock or quarry faced

In this type of masonry, the exposed faces of the facing stones between the chisel drafting all around are left undressed. However, the projections of size more than 8 cm are broken. All other specifications are kept similar to that of ashlar rough tooled masonry. This type of construction gives massive appearance.

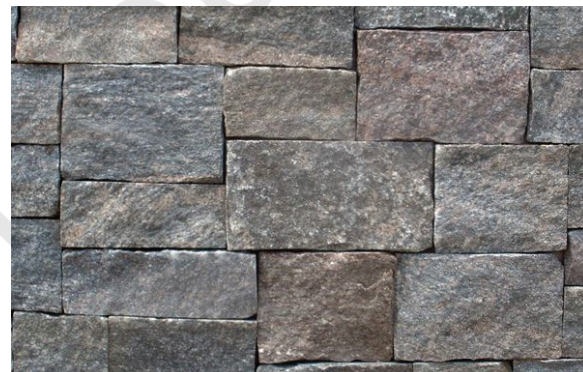


Fig. 1.18: Ashlar rock or quarry faced

### Ashlar chamfered

The specifications regarding size bonds and the type of joints are similar to the one as described above. The exposed edge of stones are levelled for a depth of about 2.5 cm (Fig.1.19).

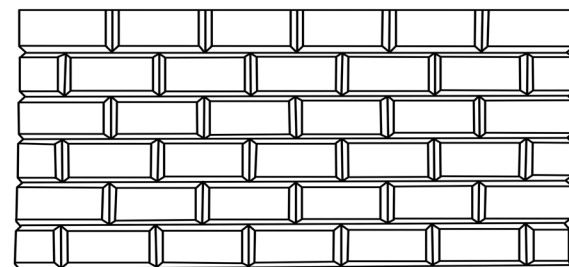


Fig. 1.19: Ashlar Chamfered

### Ashlar facing

In this type of construction the facing is constructed in ashlar masonry and the backing may be on the brick masonry, rubble masonry or concrete masonry. This arrangement of masonry leads to saving of material and money. The height of course should be more than 200 mm. The facing stones are either rough tooled or chamfered.

### Ashlar block in course

This type of masonry occupies an intermediate position between rubble masonry and the ashlar masonry. The faces of the stones are generally hammer dressed and thickness of mortar joint does not exceed 6 mm. This type of construction is used for heavy engineering works such as retaining wall, sea wall, etc.

## JOINTS IN STONE MASONRY

The joints in stone masonry can be broadly categorised in the following types.

- (1) Butt or squared joint
- (2) Rebated or lapped joint
- (3) Tongued and grooved joint
- (4) Tabled joint
- (5) Saddled joint
- (6) Rusticated joint
- (7) Plugged joint
- (8) Dowelled joint
- (9) Cramped joint
- (10) Flushed joint



Fig. 1.20: Butt joint

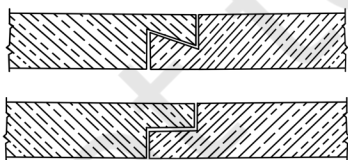


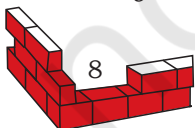
Fig. 1.21: Rebated joint

### (1) Butt or Squared Joint

This is a common joint and is extensively used for usual tasks. Square surface of one stone is placed against that of another stone in this joint. (Fig. 1.20)

### (2) Rebated or Lapped Joint

Rebates are used in these joints. These rebates prevent the movement of stones. The length of rebate varies





as per the requirement, but it should not be less than 70mm.

### (3) Tongued and Grooved Joint

In this joint, a projection of one stone gets fitted in the adjoining stone. Both stones get joined with the depression or groove. This arrangement reduces the sliding of one stone over the other. This is also known as joggle joint.

### (4) Tabled Joint

To check the lateral movement of water through the bed of the stone, a joggle joint is used. This joint is mostly used where lateral pressure is heavy, like the structure of sea walls.

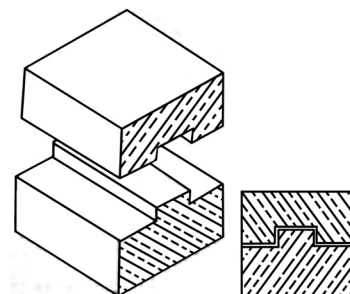
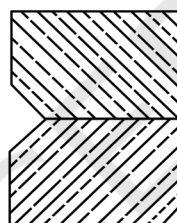


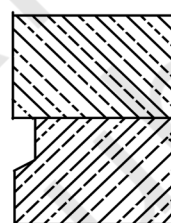
Fig. 1.22: Bed joint or tabled joint

### (5) Saddled Joint

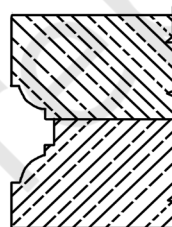
To protect the joints or cornices from rain water, the stone is rounded off, it is known as saddled joint. It diverts the water moving on the weathered surface from the joints.



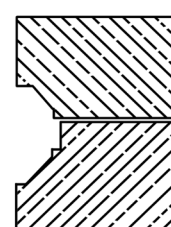
Vee Joint



Channeled Joint



Moulded Joint



Vee and Channeled Joint

### (6) Rusticated Joint

In this type of joint the edges of the joints are sunk below the plane of face work. The different types of rusticated joints can be—channeled joint, vee joint, and vee and channeled joint.

Fig. 1.23: Rusticated or rebated joint

### (7) Plugged Joint

It can also be used in place of cramped joints. In this joint, dovetail shaped mortises are kept in the sides of adjacent stones. They are sealed by pouring molten lead in the joint. The stones get connected firmly when molten lead becomes cool.

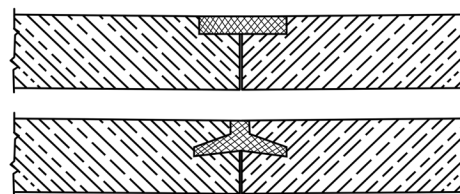


Fig. 1.24: Different forms of plug joints

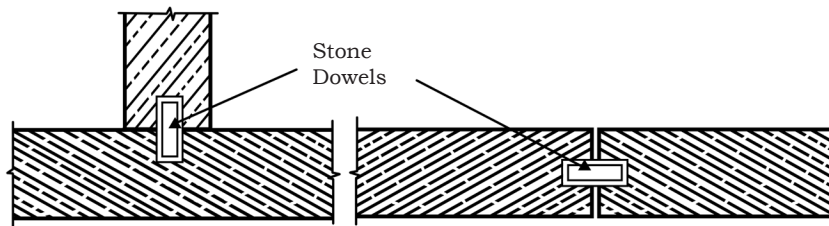


Fig. 1.25: Dowel Joint

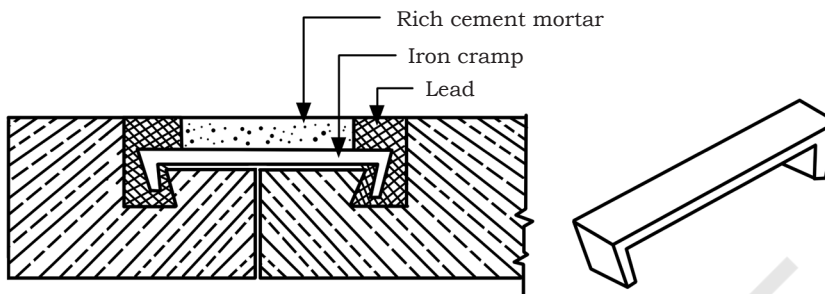


Fig. 1.26: Cramp joint

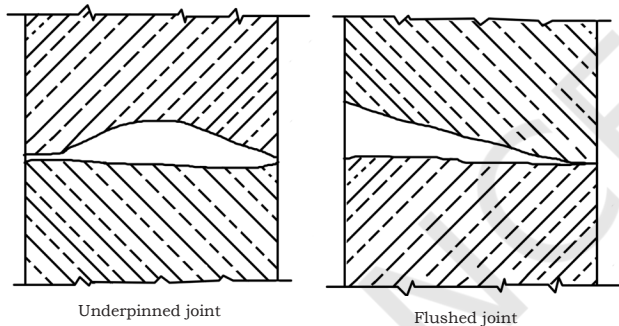


Fig. 1.27: Underpinned and Flushed joint

## (8) Dowelled Joint

In this type of joint, a hole is made into every stone in which small pieces of hard stone, slate, gun-metal brass, etc., are inserted and then sealed with cement.

## (9) Cramped Joint

When two stones are joined with the help of metal cramps, then this joint is known as cramped joint. This joint checks the stones to get away from each other.

Cramps are made up of non-corrosive metals. Cramps are inserted in stone 40–50 mm. The length, width and thickness of the cramps vary from 20 to 30 cm, 25 to 50 mm and 5 to 10 mm, respectively.

## (10) Flushed Joint

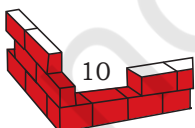
It is used in brick wall construction, when the surface requires plastering and final finishing. Thus the flushed joint will be hidden.

Construction of flushed joints takes more time and work to make it watertight and water resistant.

## MAINTENANCE OF STONE MASONRY CONSTRUCTION

Stone masonry construction should be maintained with respect to the following:

- (1) Stains
- (2) Efflorescence
- (3) Cracks
- (4) Waterproofing



## Stains

The stains on stone work can be iron stains, copper stains, smoke and fix stains, oil stains, tobacco stains and ink stains.

Iron stains can be removed by washing the stained area with the solution of oxalic acid mixed in water (1 kg of oxalic acid mixed with 10 litres of water). The stained area is rubbed with brush and water after three to four hours. In order to remove dark and deep stains, a solution having one part of sodium citrate mixed with six parts of water is sprinkled. This surface is then covered with a thin layer of sodium hydrosulphide. The surface is washed after an hour.

Copper and bronze stains are removed by application of ammonium chloride solution (one part of ammonium chloride, four parts of powdered talc) with ammonia water.

Smoke and fix stains are treated with powdered pumice or grit. The surface is rubbed several times and cleaned.

Oil stains are treated with benzene or petrol. In order to remove deep oil stains, a mixture of acetone and amyl acetal is used. A dilute solution of trisodium phosphate can be used to remove the tobacco stains.

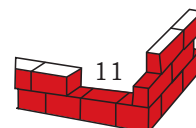
Chlorinated lime, ammonia water or concentrated solution of sodium perborate can be used to remove the ink stains.

## Efflorescence

The stones to be used for masonry work should be kept saturated with water so that they may not get discoloured because of acid action. Efflorescence is common with certain types of stones and can be prevented by having proper drainage in the building.

## Cracks

There can be small as well as large stone masonry cracks. Small cracks can be cleaned with wire brush and filled with thick paste of cement mix.



Large cracks can be raked out to get a firm key for the mortar. For this an inverted groove of at least 10 mm depth is required. A cement sand mortar of 1:2 ratio with less water is applied within an hour after mixing. Aluminium may also be added in the mixture to make it a tight fit.

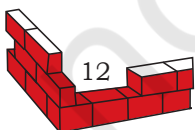
### **Waterproofing**

Application of waterproofing material makes the stone masonry free from efflorescence, dampness, frost action, etc. Generally heavy petroleum distillate, fatty oil or insoluble soap serve as excellent waterproofing matter. These materials are applied as a washing coat; they may cause some temporary discolouration.

### **LAYING OF STONE MASONRY**

#### **Points to be considered during construction**

- The stone should be hard, tough and durable.
- The stones should be well watered before use.
- There should not be any hollow space inside the wall.
- Through stones (headers) should be used in successive layers, at 1 m (3' to 5') to 1.5 m apart, both ways.
- Use artificial header (R.C.C.) in case of more width.
- Care should be taken to secure a good mortar bond throughout the masonry (approximately 20mm i.e.  $\frac{3}{4}$ "). Corner stones are prepared from the mason's hammer.
- The joints should not be too smooth, to prevent the stones from sliding down.
- The wall should be truly vertical.
- Minimum 12mm ( $\frac{1}{2}$ ") margin should be provided in column external face and masonry, to avoid the offset of rubble in plinth masonry after the plaster.



GENERAL MASON – CLASS XI



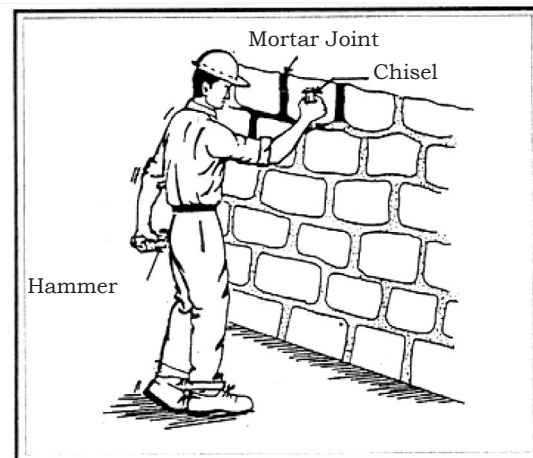
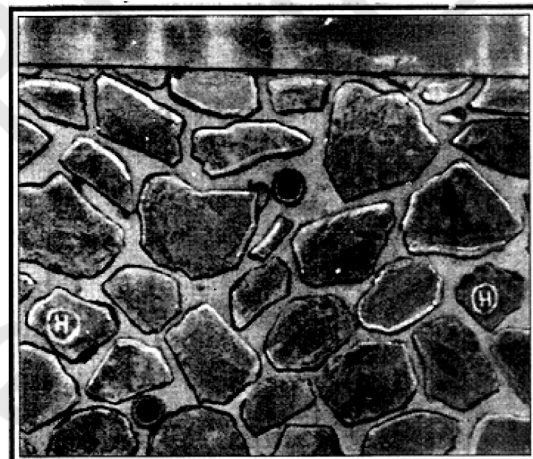
- Old work should be cleaned and watered before starting any new work on it.
- Keep expansion joint at 15m interval, in case of a compound wall.
- Lay some vertical stones in masonry for better bonding of the first and second day's work or layer of rubble masonry.
- The curing for masonry should be done for minimum two weeks.
- The through stone should be of a length which is at least thrice the depth.
- The joints should be pointed after proper curing and racking for at least 25mm (1") depth.

### **Mortar and Other Bonding Material Used for Masonry**

Mortar is a mixture of sand, water, lime and cement used in building construction for holding stones and bricks together. Mortar is placed in the joints. The selection of mortar depends on the load on structure, strength required, resistance desired for weathering agencies, etc. Mortar is classified as per its usage. Its different types are lime mortar, cement mortar, cement lime mortar and lime cement mortar.

When a portion of cement is replaced by hydrated lime, it is called 'cement lime mortar'. This mortar spreads more easily and faster. Spread with the help of a trowel, it acts as a smooth material like plastic. In 'lime cement mortar', a part of lime is removed and replaced by cement. It makes the mortar stronger, workable and more smooth. This type of mortar gets settled easily and faster.

- Masonry in cement mortar
- Masonry in lime mortar
- Masonry in mud mortar



*Fig.1.28: Dressing the stone with tools*

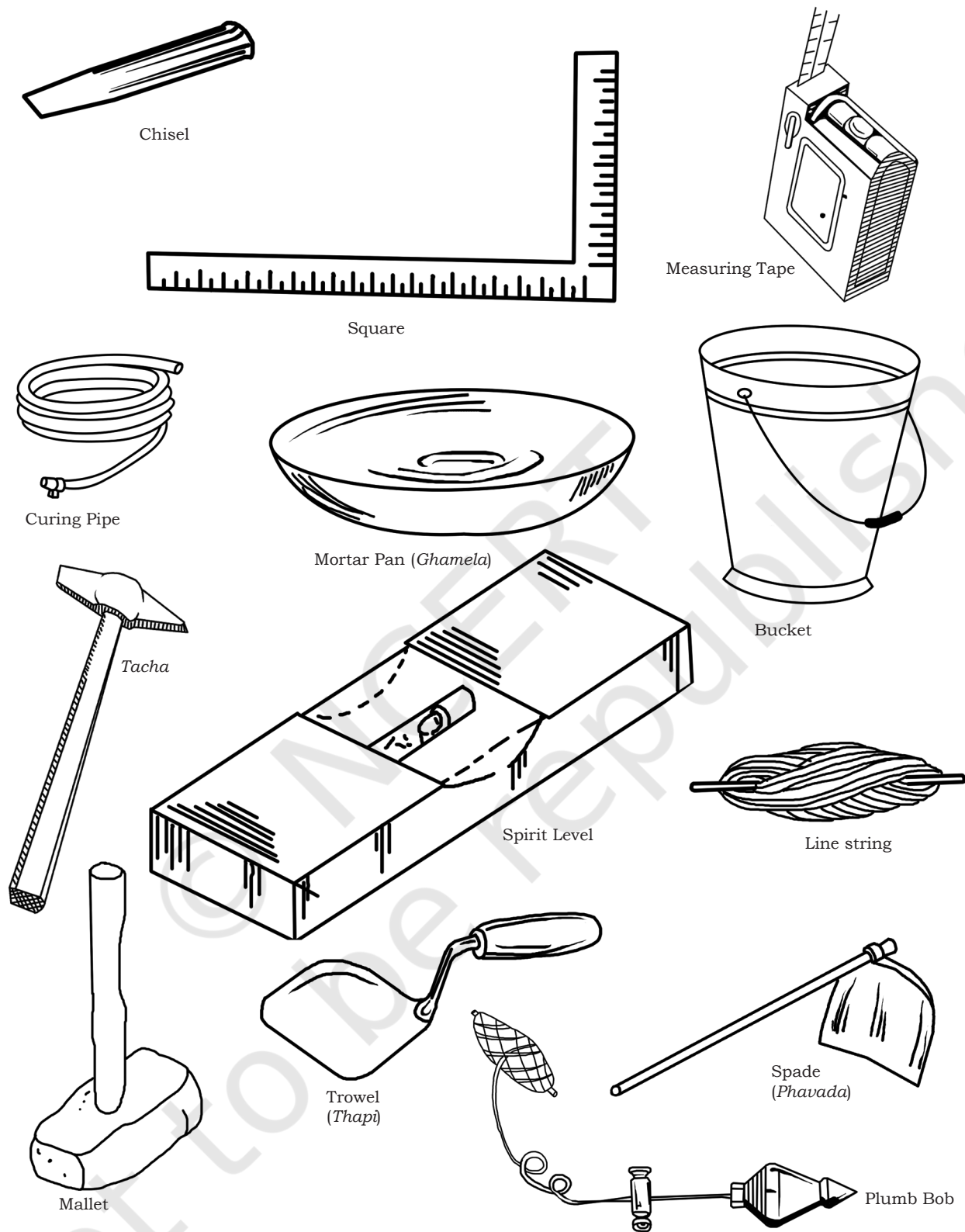
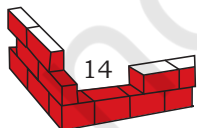


Fig. 1.29: Tools used in stone masonry



## Thickness of Masonry

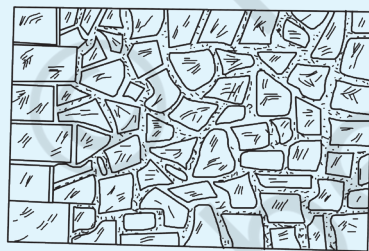
- 10 cm thick
- 20 cm thick
- 30 cm thick
- 40 cm thick
- 50 cm thick
- 60 cm thick

## Proportion of Mortar

- Masonry in cement or lime mortar 1:8
- Masonry in cement or lime mortar 1:6
- Masonry in cement or lime mortar 1:4
- Masonry in cement or lime mortar 1:2
- 1:8, 1:6, etc., is the volumetric proportion where 1 stands for cement or lime and 8, 6 stand for sand.

### Practical Activity

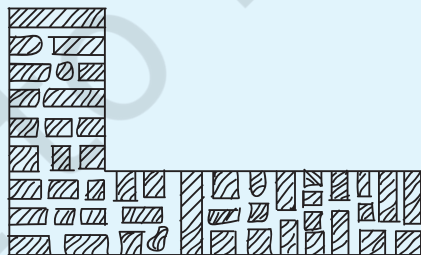
1. Students may do the practice of dressing the stone with appropriate tools.
2. Students are requested to construct coursed rubble masonry as per the drawing given below.



Elevation

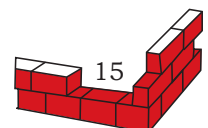


Section



Plan

STONE MASONRY



15

## Check Your Progress

### A. Short Answer Questions

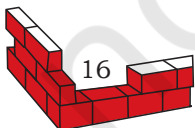
1. Differentiate between ashlar masonry and rubble masonry.
2. What is the function of the following materials?  
(a) Through stone (b) Corbel  
(c) Cornice (d) String course
3. Explain the construction of a wall in coursed rubble masonry.
4. What type of stone masonry will you use for constructing the following?  
(a) Compound wall (b) Parapet wall  
(c) Retaining wall
5. What is the object of preliminary dressing of stone at site?

### B. Fill in the blanks

1. Stone masonry is constructed with stones and \_\_\_\_\_.
2. In cramped joint, cramps are used instead of \_\_\_\_\_.
3. Butt or squared joint is the most \_\_\_\_\_ joint and is extensively used for \_\_\_\_\_ work.
4. The stones of \_\_\_\_\_ sizes and shapes are used in rubble masonry.
5. Coursed rubble masonry is commonly used in the \_\_\_\_\_ of low height walls of public buildings, residential buildings, abutment and piers of ordinary bridges.
6. The curing for masonry should be done for minimum \_\_\_\_\_ weeks.

### C. Multiple Choice Questions

1. Stone used in construction work should be \_\_\_\_\_.  
(a) hard (b) durable  
(c) soft (d) tough
2. Mortar is prepared by mixing \_\_\_\_\_.  
(a) cement (b) sand  
(c) water (d) All of the above
3. Bottom surface of a door or a window opening is known as \_\_\_\_\_.  
(a) sill (b) corbel  
(c) cornice (d) coping
4. Small cracks should be cleaned with \_\_\_\_\_.  
(a) paper (b) cloth  
(c) wire (d) brush





5. Butt joint is the most common joint and is extensively used for\_\_\_\_\_.

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|-------------------|-------------------|
| (a) heavy work    | (b) small work    |
| (c) ordinary work | (d) None of these |

**C. Long Answer Questions**

- (a) Describe the tools used in stone masonry construction with a diagram.
- (b) Write a short note on uncoursed rubble masonry.
- (c) Write the different types of ashlar masonry. Explain any one.
- (d) How the maintenance of stone masonry construction is carried out?
- (e) Enlist the types of rubble masonry. Explain any one.
- (f) List the tools used in masonry work.

